GZA
GeoEnvironmental, Inc.

Engineers and Scientists

October 5, 2006
File No. 7317.44

Mr. Robert Brackett
United States Environmental Protection Agency
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Ms. Margaret Bradley
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Re: Wetland Restoration
Proposed Soil Amendments
Former Carroll Products Facility
Richmond, Rhode Island

Dear Mr. Brackett and Ms. Bradley,

In March of 2006, GZA submitted a monitoring report to the Department of Environmental Management (DEM) for the wetland restoration effort at the former Carroll Products Facility in Richmond, Rhode Island. Recommendations in that report included the use of a zinc tolerant grass cultivar (Merlin red fescue) to re-vegetate the bare soil areas in the wetland that appear to have been affected by zinc in the soil pore water, likely from upwelling ground water leaching zinc from residual, zinc contaminated sub-soil. Based on discussions with Mr. Brackett, it is our understanding that EPA had two concerns with the proposed approach. Primarily, EPA was concerned that the proposed method of bare soil restoration did not directly address the phytotoxicity issue. A secondary concern is the potentially invasive nature of the proposed cultivar within the wetland environment.

Based on these concerns, and consultation with our client Sequa Corporation, we have revised our recommendations; we now propose to till crushed limestone into the top 1 to 2 feet of soil to raise the soil pH and immobilize the zinc.

This new recommendation was based on a more recent conversation with Dr. Rufus Chaney of the U.S. Department of Agriculture, a well known authority on mitigation of metal impacted soil.

SEPTEMBER 2006 FIELD OBSERVTIONS

A GZA wetland scientist visited the site on September 13, 2006 to observe the condition of the previously identified bare soil areas, to see if other visually impacted areas were present, and to collect surface water and soil samples from the wetland.

The former 2000 bare soil area (BSA), which was remediated by a limited soil removal and replacement action, supports essentially 100 percent cover of desirable wetland plants, dominated by wool grass and other rushes. There are no visual signs of resurgent impact to this area.

All of the subsequently identified bare soil areas were noticeably larger than in August 2005, and at least one small, additional bare soil area was developing on the western side of the wetland restoration, approximately 80 feet north of the former 2000 BSA. In addition, sparse vegetation and a coating of iron precipitate on the soil surface (which is prominent in most of the current bare soil areas) was observed in a swath abutting the western edge of the wetland restoration area, approximately 20 feet wide, and extending approximately 220 feet north of the former 2000 BSA. The swath of visual impact downgradient, and south of the former 2000 BSA is approximately 40 feet wide (abutting the eastern edge of the wetland) and 300 feet long. The visually impacted area to the north (encompassing BSA-4 and recently observed areas of impact), east (encompassing BSA-1A) and south (encompassing BSA-1B, BSA-2, and BSA-3) of the former 2000 BSA totals approximately 14,000 square feet.

Aquatic invertebrates were observed to be similar to the previous monitoring efforts. Invertebrates observed included water boatmen (Hemiptera, *Corixidae*), predaceous diving beetles (Coleoptera, *Dytiscidae*), larval and adult dragonflies (Odonata, *Anisoptera*), larval and adult damselflies (Odonata, *Zygoptera*), springtails (*Collembola*), and mosquito larvae (*Culicidae*). In addition, adult green frogs (*Rana clamitans*) and tadpoles presumed to be green frogs were numerous in the pool, and many small adult pickeral frogs were observed in the marsh vegetation.

SURFACE WATER AND WETLAND SOIL ANALYSES

Surface water samples were collected from locations SW-1, -2, and -3 and analyzed for dissolved zinc and hardness. Results are presented on the attached Table 1. Dissolved zinc detected in SW-3, which was collected immediately downgradient of BSA-1A, was 2.70 mg/l

Three wetland soil samples were collected from areas intended to be representative of both impacted and un-impacted soils (SED-302 collected from the eastern edge of the wetland), areas that have recently exhibited visible impacts (SED-301 from the small new bare area north of the former 2000 BSA), and older impacts (SED-303 from BSA-2). These samples were analyzed for total zinc and pH; results are presented on the attached Table 2. As can be seen from Table 2, zinc concentrations are correlated with the degree of visible impact, and pH values are inversely proportional. This supports the idea that zinc from the residual sub-soils is being mobilized toward the surface due to acidic conditions.

RECOMMENDED MITIGATION MEASURE

GZA representatives discussed the condition of the wetland restoration area with Dr. Rufus Chaney on May 15, 2006. Dr. Chaney pointed out that zinc has low solubility in soils with circumneutral to slightly basic pH (e.g., pH of about 7.5), and is mobile and bioavailable in

acidic soils. It was Dr. Chaney's opinion that the phytotoxicity and migration of zinc from the sub soil to the pool in the wetland restoration area could be effectively eliminated for an extended period by the addition of agricultural lime to the top soil. Dr. Chaney recommended tilling medium-grained limestone into the top 12 inches of soil, with an application rate of about 50 tons per acre. The used of medium-grained limestone (approximately ¼ to 3/8 inches in diameter) will provide sufficient surface area for short-term pH adjustment, and provide enough mass to allow for pH adjustment over an extended period as upwelling groundwater carries more zinc and hydrogen ions (i.e., acidic conditions) toward the surficial soil.

GZA recommends that the agricultural lime be tilled into the top 12+ inches of wetland soil within the 14,000 square feet that encompasses visually impacted areas. At a loading rate of 50 tons per acre, this operation would require approximately 16 tons. At approximately 2600 pounds per cubic yard of crushed limestone, this would require approximately 13 yards of limestone.

Limestone to be used will be purchased in bulk from a New England limestone quarry processed into ¼ to 3/8 inch stone. The material will be spread by hand or with a tractor-mounted rotary spreader, then the material will be tilled into the surficial soil with a tractor-mounted rototiller or equivalent. Because the work area has low relief, there is little potential for significant erosion and sedimentation. However, as a precaution, siltation fence will be installed at the downgradient edge of the work area to avoid erosion from the work area.

The ideal time to perform this work is mid-October to mid-November when the groundwater table is usually its low point. If this work is performed in the fall of 2006, there will be a sufficient seed bank in the tilled soil and contributed by the surrounding plants, therefore active seeding will not be needed. If performed in the spring or summer of 2007, additional seed will be added using Wetland Seed Mix sold by New England Wetland Inc. of Amherst, Massachusetts.

MONITORING OF THE MITIGATION EFFORT

GZA proposes to continue the current monitoring program, with one monitoring effort each year in the latter part of the growing season (i.e., late August or September). The monitoring effort will consist of:

- Visual inspections for patches of stressed or dead vegetation, or bare soils areas either within the proposed mitigation area, or any other portion of the wetland restoration area;
- Quantitative description (i.e., plant species and approximate percent cover of each) of the plant community in the proposed mitigation area, until such time that it is clear that a desirable wetland community has become re-established;
- Surface water sampling and analysis for dissolved zinc (one round of three samples each year);

- Qualitative assessment of aquatic biota in the standing pool of water within the wetland restoration area.

The results of these monitoring efforts will be presented in a report to the RIDEM and EPA following each yearly monitoring effort. We will conduct this monitoring for a minimum of three years, after which the need for additional monitoring will be evaluated based on observed conditions.

We look forward to your review and approval of the proposed remedial and monitoring effort. If you have any questions please call Ed Summerly (401-421-4140) or Timothy Briggs (508-755-1700).

Very truly yours,

GZA GEOENVIRONMENTAL, INC.

Timothy L. Briggs
Senior Technical Specialist

Edward A. Summerly, P.G.
Associate Principal

Attachments: Tables 1 and 2

Cc: Mr. Robert Iuliucci, Sequa Corporation
Mr. Brent Murray, Sequa Corporation

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TABLE 1

WETLAND RESTORATION MONITORING
DISSOLVED ZINC CONCENTRATIONS OVER TIME
1998 through 2006

Former Carroll Products Facility
Richmond, Rhode Island

Sample No.	SW-1	SW-2	SW-3
Aug. 26, 1998	0.02	0.02	0.02
Aug. 25, 1999	0.0164	0.0137	0.0164
Sept. 19, 2000	0.525	0.567	0.241
Nov. 2, 2000	0.85	1.29	1.05
Oct. 26, 2001	0.730	0.330	NA
Sept. 15, 2003	0.088	1.680	0.627
Sept. 1, 2004	0.167	0.239	1.42
Aug. 10, 2005	0.069	0.116	0.193
Sept. 13, 2006	0.130	0.18	2.70

Notes:

1. The Chronic Ambient Water Quality Criterion for dissolved zinc in survace water is 0.036 mg/l based on a hardness value of 25 mg/l as CaCO3. This is the lowest hardness value recommended to be input into regression equations to calculate hardness-based AWQCs for metals (see EPA, 1996). The average hardness value for surface water from the wetland restoration area has consistently been below 25 mg/l.

2. NA = Not Available.

TABLE 2

ANALYTICAL RESULTS FOR WETLAND SOIL SAMPLES
COLLECTED ON SEPTEMBER 13, 2006

Former Carroll Products Facility
Richmond, Rhode Island

	SED-301[1]	SED-302[2]	SED-303[3]
Zinc (mg/kg)	324	147	1330
pH	4.66	5.84	4.40
Solids (%)	75.5	79.5	82.0

Notes:

1. Sample collected from new small bare soil area forming approximately 80 feet north of the former 2000 Bare Soil Area
2. Sample collected from the eastern slope of the wetland restoration area, in a location that had no visible signs of stressed vegetation.
3. Sample collected from BSA-2.